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DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
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INFORMATION CIRCULAR

METHODS OF SAMPLING AND ANALYZING COAL-MINE DUSTS FOR INCOMBUSTIBLE CONTENT

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BY

C. W. OWINGS, W. A. SELVIG, AND H. P. GREENWALD

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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

METHODS OF SAMPLING AND ANALYZING COAL-MINE DUSTS FOR INCOMBUSTIBLE CONTENT[1]

By C. W. Owings,[2] W. A. Selvig,[3] and H. P. Greenwald[4]

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INTRODUCTION

Recent recommendations of the Bureau of Mines regarding rock dusting to prevent dust explosions in coal mines have been issued as Mine Safety Board Decision 32 and printed as Information Circular 7109.5/ The last paragraph on page 2 of I. C. 7109 states:

> After a mine or any part of a mine has been rock-dusted, samples of dust for analysis should be taken from the floor, ribs, roof, and timbers at such intervals of time as will give ample warning of need for redusting in order to maintain the required minimum percentage of incombustible in the mine dust. Details of the methods of sampling and analysis are given in Bureau of Mines Information Circular 7113.

When the Mine Safety Board had under consideration this portion of the explanatory matter accompanying Decision 32, the members realized that, while the Bureau had given information on the sampling and analysis of coal-mine dusts in a number of publications, instructions for proper procedure are scattered and some of the publications containing them are out of print. Consequently, the present authors were appointed as a committee, with Greenwald as chairman, to prepare this information circular, which gives, as concisely and simply as possible, the steps that must be taken to determine the incombustible content of coal-mine dusts and with sufficient accuracy to permit their control.

SAMPLING OF COAL-MINE DUSTS

The necessity for care in sampling cannot be emphasized too strongly. The composition of a sample should represent truly the composition of a mass of material many times its own weight. Also, analyses of all the samples are supposed to give a true cross section of conditions throughout the mine. With materials as variable as coal-mine dusts, accurate samples are not obtained by grab sampling or by careless use of good sampling methods. Points to be considered are the selection of sampling stations, frequency of sampling, methods of taking gross samples, and procedure for working them down to the size required for the determination of incombustible content in the mine office or laboratory.

In connection with explosion-prevention, coal-mine dust is defined as all material passing a No. 20 (20-mesh) sieve. It is difficult to make proper separation on this sieve underground, particularly if the dust is damp, and it has been found best to make a first separation on a 10-mesh sieve in the mine and the final separation in the laboratory.

Equipment Needed

The following equipment should be provided for proper sampling of mine dusts:

5/ Mine Safety Board Decision 32. Prevention of Coal-Dust Explosions by Rock-Dusting. Bureau of Mines Inf. Circ. 7109, 1940, 3 pp.

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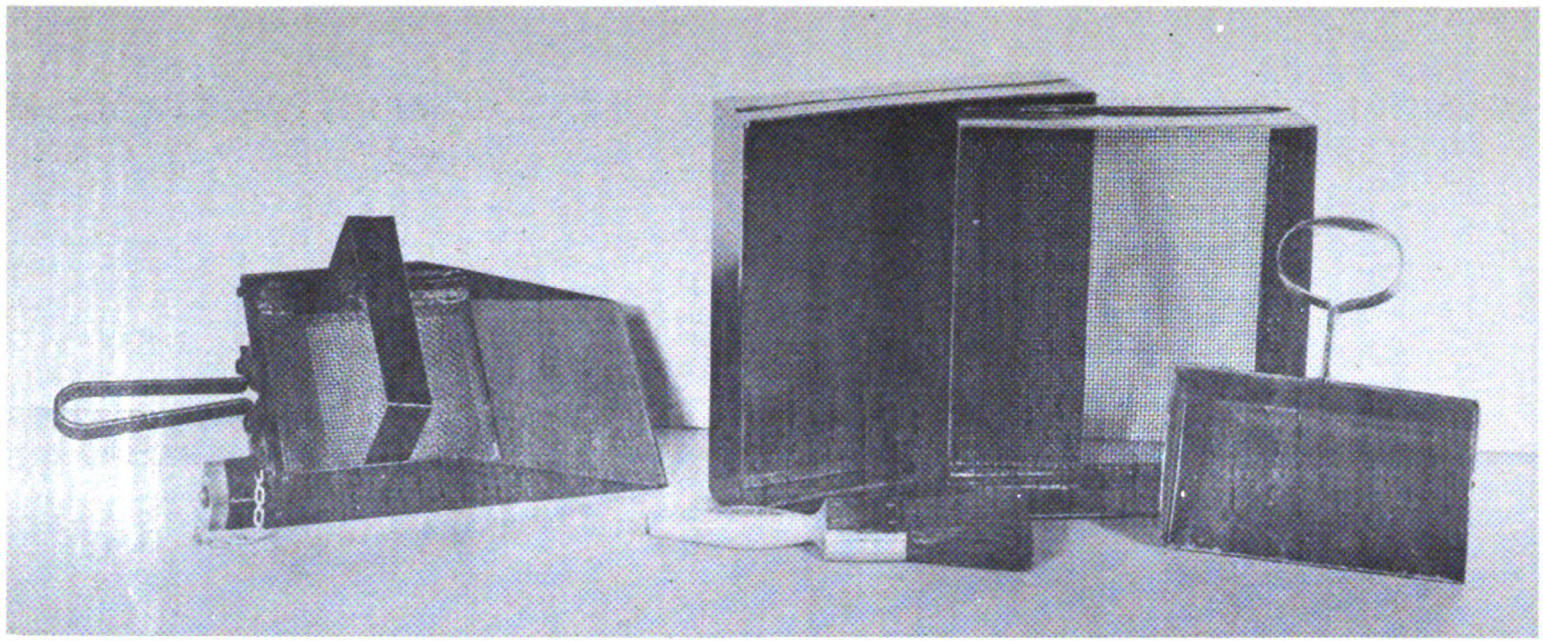

Figure 1.- Two forms of scoops for collecting coal-mine dusts.

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1. Special sampling scoop with either built-in or separate 10-mesh screen as described below. A 3-inch paint brush is used with this scoop.

2. A piece of oilcloth or rubberized cloth about 2 feet square.

3. Containers for samples; cardboard containers with metal screw tops of not less than 4-ounce size are suitable. An 8-ounce size is better from the standpoint of accuracy of sampling but adds to the weight and bulk that the sampler must carry. It must be possible to mark the containers with essential data regarding the sample. Labels that can be pasted on are best.

4. Notebook and pencil.

5. It is advantageous to have a canvas sack with shoulder straps in which all the equipment can be carried with arrangement such that any item is readily accessible without removing the others.

Sampling scoops. - The best method of collecting samples is by use of a special scoop and a paint brush. Vacuum cleaners have been advocated and used to some extent, but tests have shown that they have no advantages insofar as correctness of sampling is concerned. Furthermore, they are less easily portable than the scoop, recovery of the sample from them is more difficult, and they require a source of power not available at numerous points where sampling should be done.

The first type of sampling scoop developed by the Bureau of Mines is shown at the left in figure 1. It is 6 inches wide and combines both collecting scoop and 10-mesh separating screen for rejection of coarse material. While the sample is being collected, the pivoted member, which forms the fourth enclosing side of the screen, is turned back toward the handle. When enough material has been collected, the pivoted member is turned forward and pressed down firmly, and the scoop is then shaken so that all fine material drops through the screen. The oversize is discarded and the dust is recovered by pouring it out of the rectangular neck, which is seen at the lower rear of the scoop closed by a square rubber stopper. If dust deposits are heavy, a complete sample may have to be handled through the screen in several parts. Construction details of this scoop will be furnished by the Bureau of Mines on application. This scoop has worked well in many instances, but has also given rise to complaints in others. One complaint (probably a justifiable one) is that it is too difficult to recover samples of damp dust with it, as they will not pour out through the small neck readily, and unless they can be shaken out completely the residue may falsify the next sample collected. The contruction is such that the lower compartment cannot be brushed out. This objection may be overcome by constructing the scoop with a sliding drawer at the bottom, so that the drawer may be pulled out with its content of dust. Dust of any degree of dampness may then be recovered readily and the container cleaned before reuse.

A second form of sampling scoop with separate screen is shown at the right in figure 1. The scoop is of simpler construction and much shorter,

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which aids manipulation in some instances and places less strain on the wrist when roof, rib, and timber samples are taken. The screen box is in two parts, which can be separated to give full access to the lower compartment in which the dust sample is collected. Also, for carrying, the scoop and a 3-inch shorthandled paint brush can be nested in the bottom half of the screen and the top half inverted over them. Figure 2 is a drawing showing construction details of this scoop and a screen having a wood frame The screen shown in figure 1 has a similar sheet-metal frame.

Selection of Sampling Stations

Sampling stations should be established on main entries at points 500 to 1,000 feet apart in zones where contamination by fresh coal dust appears to be most rapid. In undulating haulageways, samples should be taken at th bottom of local dips, as coal is more likely to be spilled and dust thrown into the air by the bumping of cars at such places. However, if such locations tend to be wetter than the average of the mine, they are not particularly suitable. Spilling and scattering of dust are increased by the jarring of cars over switches and cross-overs, and 10 to 20 feet from switc points are good locations at which to establish sampling stations in many mines. In multiple entries there should be sampling stations opposite each other on all entries at each location; the condition of one entry can not be estimated from samples taken in another. This is true, also, of the aircourse where only two entries have been driven.

Cross or butt entries from which room or panel entries are turned at 300- to 600-foot intervals should have sampling stations 10 to 20 feet outby the switches to the room or panel entries. On room entries samples should be collected about midway between the mouth and face of the entry unless the room entries are longer than approximately 1,000 feet. Samples should be taken also in representative rooms in each group.

Frequency of Sampling

Where coal dust is produced or scattered in quantity, it will be found necessary to sample at least once a month in rooms, in room entries, at conveyor-discharge points, and at points along haulageways where observation shows rapid contamination. Monthly sampling will be necessary also along the portion of trackless entries near working places when they are carrying return air, as much coal dust drifts into them, particularly where coal is cut dry or where mechanical loading is practiced and the coal is not wet before loading. Particular attention should be paid to mechanical loading sections and to the passageways carrying return air from them; inspection may show that sampling is required in such locations more often than once a month.

Contamination may be less rapid considerable distances from active workings, and experience may show that less frequent sampling is allowable at such places. Trackless entries carrying intake air usually will show least deterioration of rock dusting (unless dust from the tipple is drawn into the mine), and in such places sampling at 3-month intervals may be adequate.

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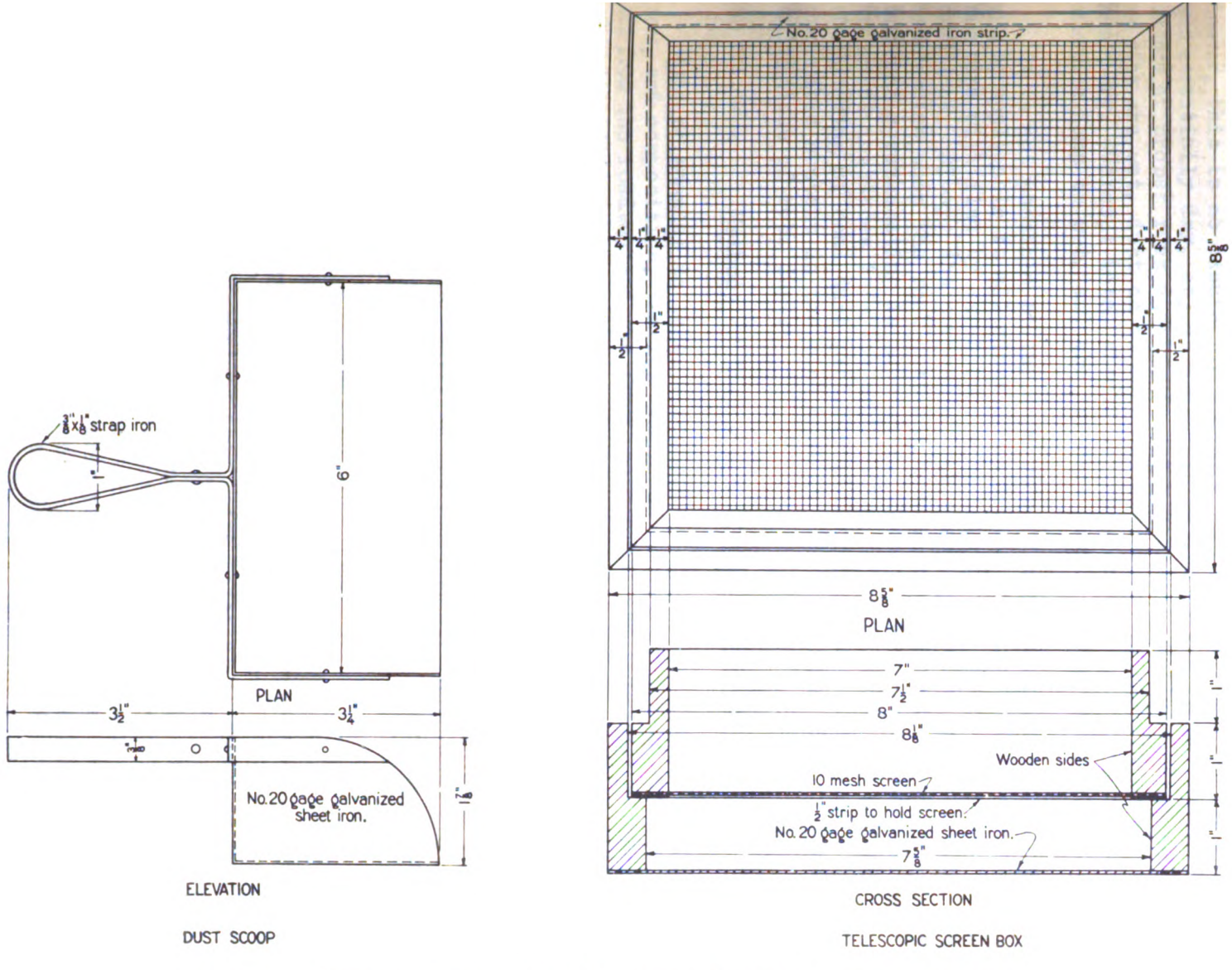

Figure 2.— Construction details of second form of scoop and screen.

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In summer sampling may have to be abandoned at points that become wet because of condensation of moisture from the air, or so-called sweating. However, this is no excuse for stopping sampling at other points that remain essentially dry, or, at the most, become only slightly damp. Maintenance of proper rock dusting is not a seasonal problem. Even where roof and ribs are wet, dust on timbers and crossbars may and frequently does remain dry. Careful watch should be kept for this condition at locations otherwise damp to wet, and the dry dust should be sampled regularly.

It is not possible to lay down rules for frequency of sampling that will be applicable to all mines. The person in charge of rock dusting in each mine will find by experience what is required under his particular conditions. Always the purpose of the sampling must be kept in mind, namely, to determine when the rock dust has become so contaminated with fresh coal dust that rerockdusting is necessary. Sampling at proper intervals also may reveal instances in which application of methods for the prevention of scattering of coal dust probably will do more toward keeping a high incombustible content in the mine dust at all times than will frequent reapplications of rock dust.

Methods of Taking and Preparing Samples

Kind of samples to take. - Because of differences in quantity, fineness, and composition, samples should be taken in pairs at any one place - one from the roadway and one from roof, ribs, and timbers. A true picture of dust conditions cannot be obtained otherwise. Coal dust on roof, ribs, and timbers is more dangerous, from the standpoint of explosion hazard, than is that on the roadway, because it is finer; and this fineness, together with its location, makes it much easier to scatter as a cloud in air. Tests in the Bureau's experimental coal mine have shown that the minimum incombustible content should be maintained in all the dust in a passageway. Under some conditions an explosion can propagate through coal dust on the roadway when there is ample rock dust elsewhere; moreover, tests indicate that essentially no amount of rock dust on the floor will stop an explosion traveling through the very finely divided coal dust dislodged from overhead timbers.

Collecting the gross sample. - On roadways, all dust in a strip 6 inches wide (the width of the scoop) is collected from rib to rib to a depth of about 1 inch, provided that loose material is found to that depth. Firmly compacted material should not be dug up. If sand is piled along the rails of haulage roads at the sampling station, a sample through it to the depth of 1 inch might give proportionately too much sand; hence, discretion must be exercised as to the amount included. Loose material on roadways usually is coarse, and a considerable part of it will be rejected by the 10-mesh screen; nevertheless, a single strip across the floor from rib to rib usually will produce a larger sample of dust than is wanted in the laboratory. The minimum to be sent for analysis is the amount that can be put in a 4-ounce container.

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When road, rib, and timber dusts are collected, care must be taken to prevent air currents from blowing the dust away, and the scoop and brush must be shielded as much as possible while in use. In collecting dust from ribs, hold the scoop as tightly against the rib as possible and brush all loose material into it from above; start at the roof and work downward to the floor, keeping the scoop and brush close together at all times, so that the dust removed by the brush will not fall outside the scoop or be blown away by the air current. Collect the material in a 6-inch-wide strip from each rib, the two strips being directly opposite each other; then collect from a 6-inch-wide strip across the roof connecting them, holding the scoop close to the roof while this is being done. If the passageway has systematic timbering, include with this sample all material that can be brushed from one timber set. In some instances where there is no timbering and ribs and roof are quite smooth a single 6-inch strip around the perimeter of ribs and roof may not yield enough dust to comprise a satisfactory laboratory sample. Under such circumstances dust from a second and adjacent complete strip around that perimeter should be added; if only part of the dust from the second strip is used, the composition of the sample is likely to be in error.

Preparing sample for the laboratory. - When the gross sample, collected from one or more 6-inch strips, must be reduced in size, the cone-and-quarter method should be used. Place the entire sample on the oilcloth or rubberized cloth previously mentioned, and mix thoroughly by lifting opposite corners of the cloth successively; this will roll the sample back and forth. Be sure that the dust rolls in the cloth and does not merely slide back and forth. Finally, gather the dust together as a cone in the center of the cloth, flatten the cone to a convenient thickness, mark it into four quarters, and cut out carefully and cleanly two diagonally opposite quarters and discard them. If the remaining half of the original sample is still too large, repeat the process as many times as may be necessary. It should be remembered that as much care should be exercised in reducing a sample in quantity as is taken in collection; there is danger of segregating portions of different size or gravity if the reduction is not made properly.

The sample containers should be marked legibly for identification. If it is desired to preserve the moisture content of the dust as collected the lids of the containers should be made airtight, with friction tape wound around the outside at the threaded joint.

A complete record of the sample and the date of sampling should be entered in a notebook when the sample is taken. This should include location, date, kind of sample, container number or other identification, dust conditions, and any other data pertinent to the sample. Where permanent sampling stations are established, it will be advantageous to have in the beginning for each one a sketch showing width, height, and general contour of perimeter, together with arrangement of any timber present; any variations, such as might be caused by falls of roof or side, or change in timbering can then be noted as they occur. All data should be transferred to a permanent record book in the mine office; the general question of records and reporting will be discussed at the end of this paper.

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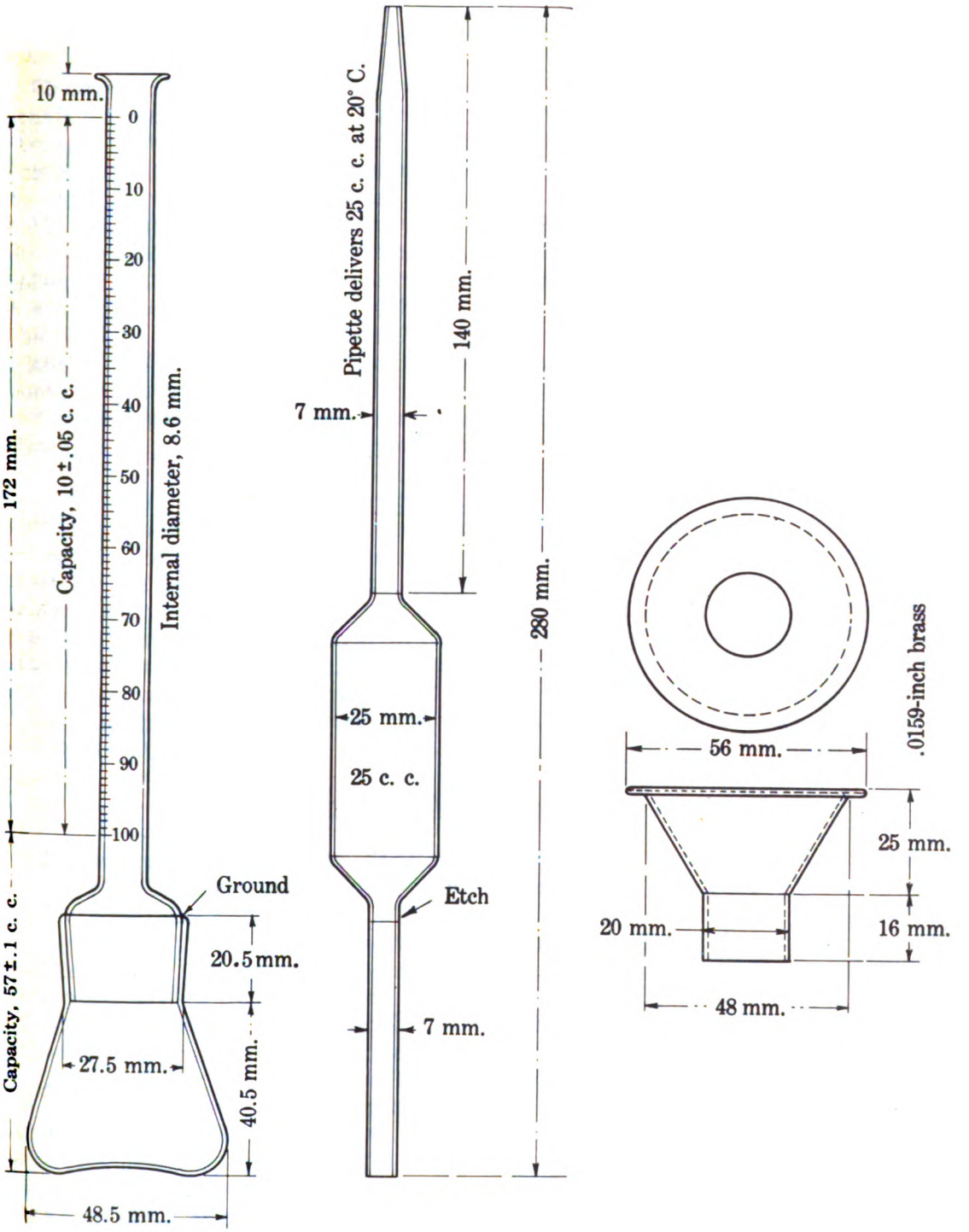

Figure 3.- Details of Bureau of Mines volumeter.

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DETERMINATION OF INCOMBUSTIBLE CONTENT

Definition of Incombustible Material

"Incombustible material" in coal-mine dust or the "incombustible content" thereof means quite literally everything in the dust that will not burn, including the moisture and ash of the coal. If the dust is damp the extra moisture present is also incombustible material. Most rock dusts sold for use in coal mines have so little combustible material (usually not more than 1 or, at the most, 2 percent) that no important error is introduced by considering them entirely incombustible. However, a number of things may be present in coal-mine dust in different instances that are not entirely incombustible. Refuse coal or roof partings, which may be cut out and gobbed, usually fall far short of being incombustible; frequently the incombustible content of the parting is as low as 25 to 30 percent. A material approaching total incombustibility is the draw slate over the Pittsburgh coal bed, samples of which, collected by the Bureau of Mines, analyzed 95 or more percent incombustible.

Methods of determining incombustible. - Determination of the incombustible content of a heterogeneous mine dust by chemical methods is not easy and should be attempted only in a well-equipped laboratory having properly trained personnel. Because many mines will not have available the necessary equipment and trained personnel for chemical analysis, the Bureau recommends a volumetric method of determining the incombustible content of coal-mine dust which is rapid and accurate enough for control purposes and requires no more than ordinary skill for operation. The instrument used is known as the volumeter, and the necessary equipment can be assembled into a portable outfit.

Bureau of Mines Volumeter

The volumeter, shown in figure 3, is a flask with a graduated stem for measuring the volume occupied by a mixture of 20 grams of dust and 50 cc. of alcohol by observing the height of the liquid in the stem. The stem is graduated into 100 equal parts, with the zero mark at the top and the 100 mark at the bottom. A 20-gram sample of coal dust occupies a greater volume than a 20-gram sample of rock dust because of the decided difference in specific gravity of coal and rock dusts. The real specific gravity of clean coal other than anthracite seldom varies beyond the limits of 1.25 and 1.35, whereas the real specific gravity of rock dust is much higher - that of limestone, for example, being 2.7. A mixture of 20 grams of coal dust and 50 cc. of alcohol in the volumeter will reach almost to the top of the stem, whereas a like mixture of rock dust and alcohol will reach only to the lower part of the stem near the 100 mark. Similarly, for any mixture of coal dust and rock dust the height of the liquid in the stem, or the volumeter reading, will be between the two extremes obtained for pure coal and rock dust. The volumeter reading will be proportional to the amount of rock dust present in the mixture; and, by referring to a calibration curve, this reading can be converted into percentage by weight of incombustible matter in the dust.

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Dry, incombustible matter, or the ash of the coal dust and the mineral matter of the rock dust, in mixtures of coal and rock dust can be determine accurately (within 2 percent) by the volumeter. For rock-dusting control, moisture is included as part of the incombustible matter, and the volumeter must be calibrated as described below.

Description of equipment. - Figure 4 shows the volumeter equipment assembled as a portable outfit for making determinations in the field. The articles included are as follows:

Two volumeter flasks and stems.
Two 25-cubic centimeter pipettes.
One balance with aluminum weighing scoop and counterweight.
One 20-gram brass weight.
One 1/2-inch camel-hair brush for cleaning weighing scoop.
One weighing spatula with 3-inch blade.
One horn spoon about 5 inches long.
One mixing spatula with 6-inch blade.
One metal funnel for transferring dust into volumeter flask (figs. 3 and 4).
One 3-1/2-inch tin funnel for filtering alcohol.
One alcohol container.
One rubber cloth for mixing sample.
One package of 6-inch filter paper for filtering alcohol.
One 8-inch No. 20 (20-mesh) U. S. Standard Sieve Series sieve, with bottom, for preparing sample.

The balance is conveniently built into the top of the carrying case. In the drawers are felt-lined recesses into which are fitted the glass parts of the outfit; or these parts may be held in place by means of spring clips. Ordinary grain alcohol is used, and the denatured variety is satisfactory.

Preparation of sample. - Before a determination is made with the volumeter the dust to be tested must be sensibly dry and be passed through the No. 20 sieve. Damp dusts usually can be dried enough by spreading them out thinly on a paper in a room for a few hours. Damp dust does not sieve well and when drying is necessary it should be done before sieving is attempted. In sieving, the entire sample should be dumped on the sieve, which should be shaken until it is evident that no more of the coarse particles will pass through into the pan beneath. Large samples containing considerable oversize may have to be divided to avoid overloading the sieve. If this is done, the material passing the sieve is remixed.

A sample loses weight while drying, and this weight is incombustible material. If this loss is to be determined, the entire sample must be weighed carefully before and after drying; when expressed in percentage, the moisture lost in drying should be included with the incombustible content found in the volumeter determination. Unless the dust is quite damp, no great error will be introduced by neglecting the loss of weight on drying, and such error as occurs will be on the side of safety. Moreover, where credit is taken for loss of moisture in the laboratory, it

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Figure 4.- Complete volumeter outfit with carrying case.

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is assumed that the dust in the mine will not dry out before the next sample is taken at the same location, possibly a number of weeks later. This assumption may not be correct in some instances.

Method of making determination. - Mix the dust thoroughly on the rubber mixing cloth by lifting opposite corners of the cloth successively and rolling the sample in all directions. A large spatula may be used to aid in this mixing operation. After mixing, spread out the sample in a smooth layer with the spatula and weigh out exactly 20 grams of dust taken with the horn spoon in small increments distributed evenly over the entire sample.

Wipe the volumeter flask and measuring tube perfectly dry and clean, especially the ground joint of the flask and tube. Place the small funnel in the mouth of the flask, and transfer the 20-gram sample from the weighing scoop into the flask; take care that none of the dust is spilled during this transfer. Finally, brush into the flask any dust adhering to the inside surface of the funnel.

Suck alcohol into the pipette until the level of the alcohol is well above the ring etched on the stem above the bulb. To guard against getting alcohol in the mouth, a piece of rubber tubing 6 inches or more long may be attached to the upper end of the pipette; the end of the rubber tubing should be provided with a short piece of glass tubing as a mouthpiece. Remove the pipette from the mouth, and place the fingertip quickly over the upper opening or mouthpiece before the alcohol level can flow below the etched ring. Hold the finger in place tightly to prevent loss of alcohol, and remove the pipette from the alcohol container. By suitable manipulation of the finger allow the alcohol to flow out slowly until the bottom of the meniscus (concave top surface of the alcohol) just reaches the etched ring above the bulb. Then insert the tip of the pipette into the volumeter flask, and allow the alcohol to flow into the flask. As soon as the free-running stream has stopped, touch the tip of the pipette to the side of the flask, and blow out at once the adhering drop of alcohol. Remove the pipette before any more alcohol can drain down. In using the pipette, care must be taken that it is filled to the mark and that no alcohol is lost after the meniscus has been adjusted to coincide with the mark etched on the stem.

Insert the measuring tube of the volumeter into the flask, and shake to wet the dust thoroughly with alcohol and allow air bubbles to escape. Visual inspection through the bottom of the flask will determine when the sample is completely wet. As two volumeters usually are included with each outfit, care must be observed to use the proper measuring tube, as they are not interchangeable on the flasks. A number should be etched on the neck of each flask and its corresponding measuring tube. Use of the wrong measuring tube with a given flask may give erroneous results.

After the volumeter has been shaken introduce a second 25-cc. volume of alcohol from the pipette through the top of the measuring tube. Let

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the mixture stand for 30 seconds, then read the bottom of the meniscus in the measuring tube. By reference to a calibration curve, this reading gives the approximate percentage by weight of incombustible matter in the dust sample.

The alcohol may be recovered and used repeatedly. This is done best by pouring it into a container; after settling, the alcohol can be poured off the dust and filtered through a filter paper to remove any dust held in suspension. The alcohol will become colored on repeated use; this does not affect results.

Calibration of Volumeter

The success of the volumeter method depends on the instrument being calibrated properly for the particular coal dust and rock dust found in the mine for which determinations are being made; this means a calibration for each mine, but calibrations for adjacent mines in the same coal bed using the same rock dust may be very similar. The calibration point determined by the rock dust should be the same for all mines using the same brand of dust. Incombustible matter is taken as the sum of all moisture, the ash of the coal, and the mineral matter of the rock dust. If the volumeters are manufactured to meet the tolerances given in figure 3, it is not necessary to calibrate each volumeter separately; however, it is advisable to do so, as some volumeters may not be within the tolerances.

Moisture cannot be determined by the volumeter, because addition of as much as 10 percent moisture to dry coal dust gives a negligible change in the volumeter reading. For this reason, the moisture content of the coal dust used for calibration should equal that of the coal dust in normal mine dust, so that the volumeter will be calibrated to include the moisture as part of the incombustible.

For calibration purposes at least two samples of representative coal dust should be collected from the ribs and roof in advance of rock dusting - that is, close to working faces. The dust should be dry to the touch. Road dust should not be used, as such dust may contain extraneous matter and may not be representative of the coal dust in the mine.

The samples of coal dust are collected as described above. They are placed in airtight containers in the mine to prevent subsequent changes in moisture content. A sample of the rock dust being used is also required. Volumeter determinations are made in duplicate on portions of the coal dust and rock dust, according to the procedure described, and the average is taken for calibration purposes.

In the laboratory, that part of the coal dust that passes a No. 20 sieve is analyzed for moisture and ash content, care being taken to obtain an accurate determination of total moisture. The methods used are the standard methods for analysis of coal.6/

6/ American Society for Testing Materials, Standard Methods of Laboratory Sampling and Analysis of Coal: A.S.T.M. Standards, part III, 1939, p. 15.

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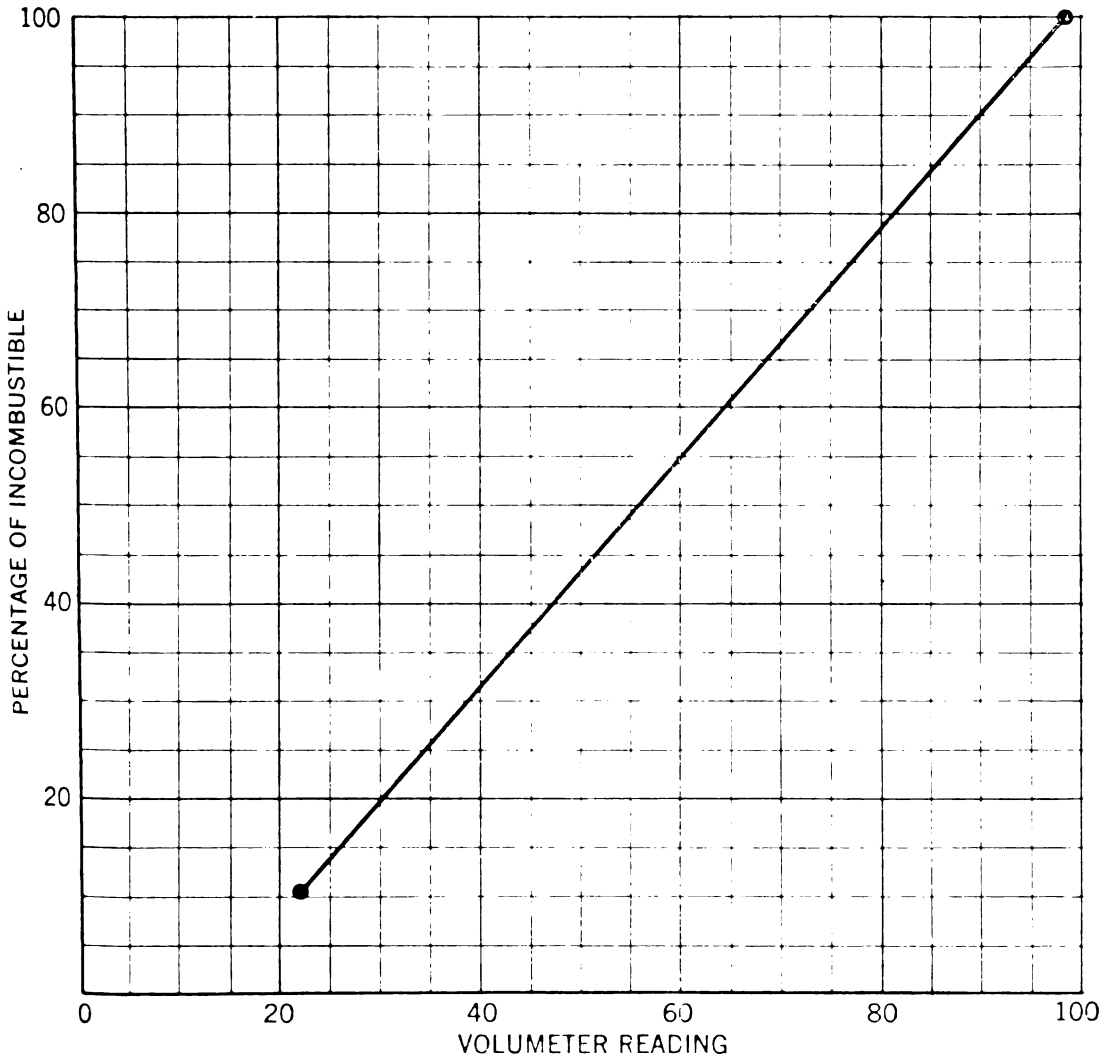

Figure 5.- Curve showing relation between readings of Bureau of Mines volumeter and percentage of incombustible in mixtures of Pittsburgh coal and limestone dust.

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If the rock dust is a good grade of limestone or dolomite it can be assumed to contain no combustible matter, and the incombustible can be taken as 100 percent. If limestones are contaminated with organic material it is necessary to analyze for moisture, carbon dioxide, and ash, and the incombustible is taken as the sum of these.

If shale dust is used, it is necessary to analyze it for incombustible content. Incombustible in shale is taken as the sum of moisture, combined water, ash, and carbon dioxide, if present. Moisture is determined on a 1-gram sample crushed to pass a No. 60 sieve by drying for 1 hour at 105° C.; ash is determined by heating the residue from the moisture determination to constant weight at a temperature of about 900° C. Combined water is determined by the Penfield tube method.[1/] Carbon dioxide, if present, is determined by the acid-evolution method,[8/] whereby the sample is treated with hydrochloric acid and the carbon dioxide evolved is collected in a solution of potassium hydroxide and weighed.

Mines not having properly equipped chemical laboratories will be able to obtain these analyses from commercial laboratories doing this kind of work. If the rock dust is obtained from a large producer, the vendor usually will be able to furnish an analysis of his dust which can be used for the purpose of calibration.

Knowing the volumeter readings for the coal dust in a given mine and for the rock dust being used, a calibration curve is made by plotting on coordinate paper the volumeter readings against the percentage of incombustible matter in the dusts. A straight line connecting these points constitutes the calibration curve, giving percentages of incombustible matter in any mixture of the same coal and rock dust from the volumeter readings. Figure 5 shows such a calibration curve prepared for mixtures of limestone dust and a coal dust from a mine operating in the Pittsburgh bed. Its preparation illustrates the method to be used in making a calibration curve for other coal- and rock-dust mixtures. The volumeter reading for the coal dust was 22, and analysis showed that it contained 10.5 percent incombustible matter (moisture plus ash). These two values determine the point at the lower end of the straight line on figure 5. A point was located in the same manner for the limestone dust, which was taken as 100 percent incombustible matter and gave a volumeter reading of 98.5. The straight line drawn on the chart connecting these points constitutes the calibration curve.

1/ Washington, H. S., The Chemical Analysis of Rocks: John Wiley & Sons, New York, 3d ed., 1919, pp. 213-216.

8/ Stanton, F. M., Fieldner, A. C., and Selvig, W. A., Methods of Analyzing Coal and Coke: Bureau of Mines Tech. Paper 8 (edition of 1938), 1939, pp. 25-27.

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The following example illustrates the use of this calibration curve. Assume that a mixture of the above coal dust and rock dust gives a volumet reading of 60. Referring to figure 5, locate 60 on the horizontal scale, follow a vertical line to the calibration curve, then follow a horizontal line from this point on the curve to the vertical scale, which shows 55 percent by weight of incombustible matter in the mixture. If the sample had an air-dry loss that was determined by weighing as mentioned previous this loss should be included as incombustible matter. To do this, use th following formula:

$$I_T = I_V (1 - 0.01 M) + M$$

in which I_T is total incombustible in percentage, I_V is percentage incombustible indicated by the volumeter, and M is the percentage of moisture indicated by the air-dry loss.

RECORDS AND REPORTS

The data on sampling and analysis of coal-mine dusts form a valuable record of the condition of the mine as regards hazard of propagation of a coal-dust explosion and should be kept in a permanent form, preferably in a book designed for that purpose. In some instances the record will be useful in relations with State mine inspection and insurance services.

The recorded data should include the date of sampling, location, kind of sample, container number or other identification thereof, dust conditions at location, whether more than one 6-inch strip was taken, and any other information pertinent to the sample as taken underground. The size and configuration of the sampling station should be recorded; if permanent sampling stations are established, these data change only as falls of roof and side occur or as timbers are changed. The record from the laboratory should include condition of sample as received (dry, damp, or wet), loss of weight on drying, if determined, and incombustible conte

Reports of sampling and analysis should be furnished to the general superintendent, superintendent, mine foreman, and safety engineer, and the person having responsibility should take promptly whatever action the samples show to be necessary. It will be advantageous to have a map on which to post the extent and date of rock dusting and the condition of the rock dust at last analysis.

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